POURED-IN-PLACE LIGHTWEIGHT CONCRETE CONSTRUCTION COMPONENTS AND METHOD OF CONSTRUCTION

Inventors: Michael S. Rodgers
428 Church Street
Madison, Mississippi 39110

Jerry M. Hensen
918 N. Avenue U
Lubbock, Texas 79415

(U.S. Citizens)

Attorney Docket: 3353.49547

CERTIFICATE OF MAILING BY "EXPRESS MAIL"

"Express Mail" Mailing Label Number EV 066748275 US Date of Deposit July 03, 2003

I hereby certify that this paper or fee is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. § 1.10 on the date indicated above and is addressed to: Box Provisional Patent Application, Assistant Commissioner for Patents, Washington, D.C. 20231.

July 03, 2003
Date

Signature of Person Mailing

William P. Glenn, Jr.
Printed Name of Person Mailing

POURED-IN-PLACE LIGHTWEIGHT CONCRETE CONSTRUCTION COMPONENTS AND METHOD OF CONSTRUCTION

DESCRIPTION

TECHNICAL FIELD: This invention relates generally to lightweight concrete used in the construction of buildings and other structures. More particularly, it relates to poured-in-place lightweight concrete walls and horizontal components for use as a floor, ceiling or roof of a building or other structure. Lightweight concrete walls, floors, ceilings or roofs formed in such a manner are easy to construct, build out and finish and when cured, are resistant to impact loads.

BACKGROUND ART: In general, concrete has been used to construct walls and horizontal components such as floors, ceilings and flat roofs. However the construction of each type of slab presents a number of challenges. With respect to wall and floor slabs, the adjacent earth must be stabilized and prepared to receive and hold the concrete slurry to be poured. Without proper stabilization of the adjacent earth, a cured wall or floor slab may shift or crack. Preparation may include trenching and leveling the adjacent earth before pouring. Forms made of wood or steel are used to retain the concrete slurry and are removed after curing. Depending of the function of the concrete wall or floor slab, reinforcing bars are cut, wired together and positioned inside the form in such a manner as to add internal strength to the surrounding concrete slurry once cured.

Building construction that requires walls, floors, ceilings or roofs is typically carried out through the use of prefabricated modular concrete components or slabs. Such prefabricated modular slabs are typically poured, cured and stored offsite until required at the construction site. Typical prefabricated modular slabs are heavy and pose unique challenges in lifting to the final position at the construction site. An alternative is to pour in place. Similar to pouring a slab on the ground, a form must be constructed to hold a concrete slurry in place until cured. Furthermore, a comprehensive network of supports must be constructed to elevate and support the form and concrete slurry until cured. Thereafter the forms and supports are disassembled and removed from the construction site.

If insulation is required, the construction process includes the addition of insulative materials in the form of fiberglass batts, blown-in insulation, or the use of foam (sprayed or in board form). If conduits or utility ways are required, then the forming of conduits within the form is required before the concrete slurry is cured. This requires the architect, engineer, and/or builder to plan ahead. As can be appreciated, additions after-the-fact require cutting the concrete or making workarounds, both of which are very expensive.

In view of the above described deficiencies associated with concrete walls and horizontal components, the present invention has been developed to alleviate these drawbacks and provide further benefits to the user. These enhancements are benefits are described in greater detail hereinbelow with respect to several alternative embodiments of the present invention.

SUMMARY OF THE INVENTION: This invention includes features and components that have been invented and selected for their combined benefits and superior performance as poured-in-place lightweight concrete walls and horizontal components. Each of the individual components work in association with the others and are optimally mated for superior performance.

Referring now to specific embodiments of the lightweight concrete construction components and several of its applications in the building construction business, additional benefits and advantageous features will be appreciated. One embodiment of the present invention is the formation of a slab (horizontal and/or vertical) between adjacent support members, like studs or joists. The support members are preferably metal and secured to a stem wall or other suitable load bearing structure. A retaining layer system, in the form of a metal lath and barrier is applied to the outer regions of the structural members. Extending the retaining larger system access the outer region of the structural members completes a space into which a lightweight concrete slurry may be poured and thereafter allowed to cure to provide a strong, thermally insulating filler that has the ability to withstand severe impact, up to and including forces generated by storms or even high heeled foot traffic. In another embodiment, only one outer region of the structural members are covered by a retaining layer system. The remaining outer regions of the structural members are spanned by a removable forum, thereby completing a space into which a lightweight concrete slurry may be poured. In yet another embodiment, particular to horizontal components, a retaining larger system is fixed across a lower

outer region of adjacent structural members to form space into which a lightweight concrete slurry may be poured.

In another embodiment, a layer of insulative material is fixed within said lightweight concrete slurry. While described here as a retaining layer system between a pair of structural members, the metal lath and/or the barrier may extend over both sides of a plurality of structural members so as to form an extended retaining layer system support. When the lightweight concrete cures, the exposed face of the retaining layer system or metal lath may be finished with a veneer such as stucco to give the surface an attractive finish. Any forms are removed, and the surface may be finished with a covering.

Among those benefits and improvements that have been disclosed, other objects and advantages of this invention will become apparent from the following description taken in conjunction with the accompanying drawings. The drawings constitute a part of this specification and include exemplary embodiments of the present invention and illustrate various objects and features thereof.

BRIEF DESCRIPTION OF THE DRAWINGS: The invention will now be described in greater detail in the following way of example only and with reference to the attached drawings, in which:

Figure 1 is a cross sectional view showing a structure with poured-in-place lightweight concrete walls and horizontal components.

Figure 2 is a cross sectional view of a floor slab showing a retaining layer system for concrete poured as a slurry between adjacent joists.

Figure 3 is a cross sectional view of a ceiling slab showing a retaining layer system for concrete poured as a slurry between adjacent joists.

Figure 4 is a perspective view of a floor slab showing a retaining layer system for concrete poured as a slurry between adjacent joists.

Figure 5 is a cross sectional view of a horizontal slab with an insulative material positioned between layers of a lightweight concrete slurry.

Figure 6 is a cross sectional view of a horizontal slab with a barrier that covers joists and lath.

Figure 7 is a perspective view of a horizontal slab with joists, a reinforcing member and a utility conduit.

Figure 8 is a cross sectional view of a wall depicting a retaining layer system for concrete poured as a slurry between adjacent studs.

Figure 9 is a perspective view of a wall depicting a retaining layer system for concrete poured as a slurry between adjacent studs.

Figure 10 is a perspective view of a wall depicting another embodiment of a retaining layer system for concrete poured as a slurry between adjacent studs.

DETAILED DESCRIPTION OF THE INVENTION: As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention

that may be embodied in various and alternative forms. The figures are not necessarily to scale, some features may be exaggerated to show details of particular components. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention.

Furthermore, elements may be recited as being "coupled"; this terminology's use anticipates elements being connected together in such a way that there may be other components interstitially located between the specified elements, and that the elements may be connected in fixed or movable relation one to the other.

The present invention extends the use for lightweight concrete as disclosed in United States Patent No. 5,737,896; a patent which is hereby expressly incorporated by reference for disclosure purposes.

Referring to Figures 1, 4, and 9, poured-in-place concrete components 10 are supported by a load bearing structure 11. The upper most horizontal slab 12 depicted in Figure 1 is supported by a load bearing wall 14; whereas the lower most horizontal slab 12 is supported by a stem wall 11. The walls 14 are supported by a load bearing structure 11, in this case a stem wall. In both horizontal slabs 12 depicted in Figure 1, support members 20, in the form of joists, span the distance between load bearing structures 11. As a wall 14, support members 20 are in the

form of studs which are fixed at one end region to a load bearing structure 11. Support members 20 can also be in the form of trusses (not shown).

Support members 20 can be metal, plastic, wood, or a combination thereof. Support members 20 must have sufficient dimensions and configuration to be placed in a pattern between load bearing structures 11 or 14 to reinforce a concrete component 10 for its intended purpose as a wall, floor, ceiling or roof. In a preferred embodiment, support members 20 are constructed out of light gauge metal between approximately 10 and 25 gauge steel and having a "C" cross section. It is further contemplated that the cross section of a support member 20 may be in the form of an "I", "L", "T", rectangle, polygon, arc, circle or a combination thereof. For a one-story residential structure, support member 20 may be formed from 20 gauge steel.

Each support member 20 may be bolted or otherwise secured to a load bearing structure 11 or 14. The separation between support members 20 may range between 16" to 30" between centers. In a preferred embodiment, the spacing is approximately 28" to 30" between centers. Walls 14 and/or load bearing structures 11 act as an end plate to complete the creation of a segmental form 30 between structural members 20. As shown in Figure 7, reinforcing members 34 can be fixed to adjacent structural members 20 to improve the strength of a horizontal slab 10. Furthermore, as shown in Figure 7, utility conduits 80 and stubs 82 can be placed within a segmented form 30 to allow the passage of electricity, water, sewage, telephone lines, data communication lines, and the like. It is further contemplated that openings (not shown) can be formed in a concrete component 10 by placing

fixed or removable inserts (not shown) with a segmented form 30, thereby preventing a concrete slurry from occupying the space delineated by the insert.

Once a segmented form is created, a lightweight concrete slurry is poured and allowed to cure (See Figs. 3 and 10). Thereafter, conventional coverings like ceiling tiles 70 (Fig. 3) for ceilings or flooring 60 (Fig. 2) for floors or covering 90 for walls (Fig. 9) may be applied. Where a concrete component 10 requires insulation, the insulating fill material included in a lightweight concrete as described in U.S. Patent No. 5,737,896 can be used. Where additional insulation is required, insulative material 52 like foam board is cut and placed adjacent to at least one lightweight concrete surface of a mixture 50. In a preferred embodiment, an insulative material 52 is positioned between two layers of lightweight concrete 50 (see Figures 5 and 6).

To form a segmented form 30, structural members 20 are disposed within a retaining layer system 36. A retaining layer system 36 includes a lath 32 which is dimensionally stable when affixed to and spans across at least one exterior region of adjacent structural members 20. Such dimensional stability allows a retaining layer system 36 to retain at least a significant amount of a lightweight concrete slurry 50 within a segmented form 30. It is further contemplated that the lath 32 has a plurality of apertures configured to allow a small quantity of a lightweight concrete slurry 50 to exude through, thereby causing securement of the lath 32 to the concrete slurry 50 when cured.

In another embodiment, retaining layer system 36 includes a lath 32 affixed to one exterior region of adjacent structural members 20; and a form structure (not shown) removably fixed to and spanning across an exterior region opposite of the lath 32 to form a segmented form 30. Once a lightweight concrete slurry cures in a segmented form 30, form structure (not shown) is removed, exposing a concrete surface. In another emobidment, a retaining layer system 36 includes lath 32 affixed across opposing exterior regions of adjacent structural members 20 to form a segmented form 30. In such an emobidment, no form structure is required to retain a significant amount of a lightweight concrete slurry.

A further alternative embodiment of a retaining layer system 36 includes a barrier 40 disposed between a substantial portion of a lath 32 and a lightweight concrete slurry 50 to significantly reduce (or even eliminate) a lightweight concrete slurry 50 from exuding through lath 32 or from the segmented form 30. As shown in Figs. 2, 3, 4 and 9, barrier 40 is in the form of a layer which extends between adjacent structural members 20. As shown in Figs. 5, 7 and 10, barrier 40 spans across adjacent structural members 20. As shown in Fig. 6, barrier 40 can be disposed between a structural member 20 and a lightweight concrete 50. It is further contemplated that barrier 40 can be place adjacent to a lath 32 to prohibit a small quantity of a lightweight concrete slurry 50 from exuding through lath 32. In such an emobidment, lath 32 functions only to retain and form a lightweight concrete slurry 50 as it cures. It is further contemplated that in such an arrangement, lath 32 and barrier 40 could be removed after curing. Barrier 40 can be manufactured from

metal, plastic, wood, composite materials and/or any other materials which eliminates or at least reduces the amount of lightweight concrete slurry 50 which could exude through lath 32. Additionally, barrier 40 can be manufactured from materials which protect structural members 20 from moisture within adjacent lightweight concrete 50. Furthermore, barrier 40 can be manufactured from insulative materials to further provide insulative qualities to a concrete component 10.

Lath 32 can be in the form of a plurality of strips fixed adjacent to each other to form a plurality of apertures (not shown). In a preferred embodiment, lath 32 is in the form of a sheet having a plurality of apertures (See Figs. 4, 7, 9 and 10). Whether lath 32 is in strips or sheets, apertures are configured to primarily provide dimensional stability and secondarily allow the passage of a small quantity of a lightweight concrete slurry 50 from a segmented form 30. Such apertures can be circular, rectangular and/or polygonal. In a preferred embodiment, metal lath typically used as an underlying structure for receiving stucco can be included in a retaining larger system 36.

A preferred segmented form 30 is constructed from a retaining layer system 36 which includes a metal lath 32 typically utilized as an underlying structure for receiving stucco on an otherwise flat surface such as a cinder block wall. A retaining layer system 36 is placed at an outer region of structural members 20 to form a segmented form 30 to receive and confine appropriately mixed lightweight concrete 50 between structural members 20 in a poured-in-place manner. A

retaining layer system 36 can be screwed or otherwise held in place against structural members 20.

Where structural members 20 are horizontal, typically there is no need for the retaining layer system 36 to confine the lightweight concrete at an upper region of a segmented form 30. Where the structural members 20 are vertical, a segmented form 30 is created by placing structural members 20 within a reatining layer system 36 with at least one lath 36 positioned to retain a significant portion of a lightweight concrete slurry 50. Attachment of lath 36 is achieved by screwing or otherwise holding it against structural members 20. An alternative contemplates formation of a segmented section 30 by screwing or otherwise holding a lath 36 against an outer region of structural members 20 and opposite to a tradional form structure removably fixed to another outer region of structural members 20. Once cured, the form structure is removed to expose a surface of the lightweight concrete 50.

The consistency of the lightweight concrete mixture 50 allows it to flow around features like utility conduits 80, studs 82 or reinforcing members 34 within a segmental form 30. Furthermore, the consistency of the lightweight concrete slurry 50 allows some exuding through a lath 32. Such exuding makes lath 32 an integral part of a concrete component and further provides structural strength not unlike traditional reinforcing members placed within a concrete form.

The use of lightweight concrete to replace traditional insulation in buildings provides significant benefits. One such benefit is the provision of a structure having walls, floors, ceiling and/or roofs made substantially of concrete. Previous

construction using concrete panels required their fabrication off-site, then erection of the panels using a crane or other suitable lifting equipment to erect complete walls of the cured concrete panels into place. The method of forming lightweight concrete components-in-place according to the present invention obviates the need for heavy lifting equipment since the concrete 50 may be mixed in small batches before being poured into segmental forms 30. It is possible for the lightweight concrete mixture 50 to be poured in stages to allow limited heights of concrete to set and form a base for the next insertion of insulative material 52, upon which the next quantity of lightweight concrete mixture 50 will be poured (See Figs. 5, 6 and 10). Such an approach eliminates or at least reduces the likelihood of an insulative material 52 moving out of position.

Using the poured-in-place construction method according to the present invention, creates a solid concrete component like a wall, ceiling, floor or roof, which is reinforced by structural members 20, lath 32 and reinformcing members 34 (where used). Such a wall, floor, ceiling, or roof is non-flammable and possesses considerable strength. Once cured, the lightweight concrete slurry 50 and lath 32 provide a surface capable of resisting the strongest of impact forces, including forces generated by weather and/or foot traffic. With such attributes, structures erected with reinforced components using the methods of the present invention are ideally suited for low cost and affordable construction with concrete.

These and other variations which will be appreciated by those skilled in the art are within the intended scope of this invention as claimed below. As previously

stated, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention that may be embodied in various forms.